

SHIP PRODUCTION COMMITTEE  
FACILITIES AND ENVIRONMENTAL EFFECTS  
SURFACE PREPARATION AND COATINGS  
DESIGN/PRODUCTION INTEGRATION  
HUMAN RESOURCE INNOVATION  
MARINE INDUSTRY STANDARDS  
WELDING  
INDUSTRIAL ENGINEERING  
EDUCATION AND TRAINING

September 1981  
NSRP 0008

# **THE NATIONAL SHIPBUILDING RESEARCH PROGRAM**

## **Proceedings of the REAPS Technical Symposium**

### **Paper No. 13: Ship Structural Cost Program**

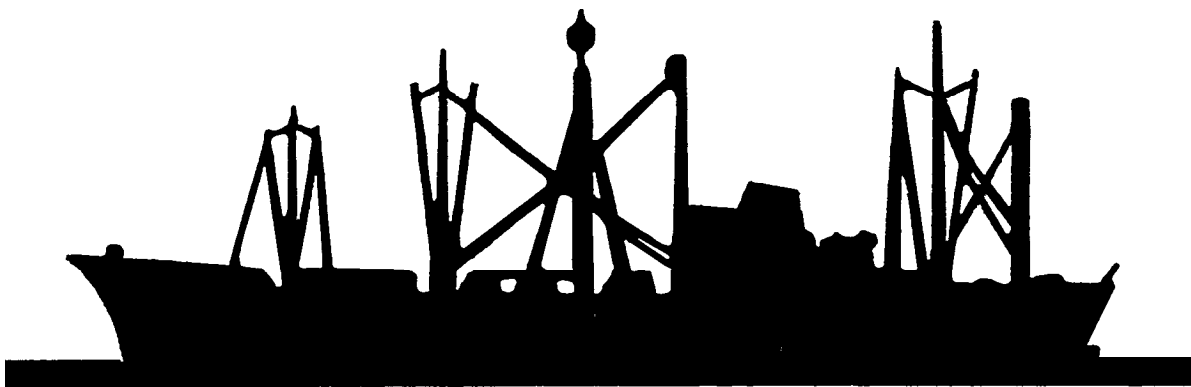
U.S. DEPARTMENT OF THE NAVY  
CARDEROCK DIVISION,  
NAVAL SURFACE WARFARE CENTER

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>SEP 1981</b>		2. REPORT TYPE <b>N/A</b>		3. DATES COVERED <b>-</b>	
4. TITLE AND SUBTITLE <b>The National Shipbuilding Research Program Proceedings of the IREAPS Technical Symposium Paper No. 13: Ship Structural Cost Program</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Naval Surface Warfare Center CD Code 2230 - Design Integration Tools Building 192 Room 128 9500 MacArthur Blvd Bethesda, MD 20817-5700</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release, distribution unlimited</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>SAR</b>	18. NUMBER OF PAGES <b>18</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

## DISCLAIMER

These reports were prepared as an account of government-sponsored work. Neither the United States, nor the United States Navy, nor any person acting on behalf of the United States Navy (A) makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness or usefulness of the information contained in this report/manual, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or (B) assumes any liabilities with respect to the use of or for damages resulting from the use of any information, apparatus, method, or process disclosed in the report. As used in the above, "Persons acting on behalf of the United States Navy" includes any employee, contractor, or subcontractor to the contractor of the United States Navy to the extent that such employee, contractor, or subcontractor to the contractor prepares, handles, or distributes, or provides access to any information pursuant to his employment or contract or subcontract to the contractor with the United States Navy. ANY POSSIBLE IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR PURPOSE ARE SPECIFICALLY DISCLAIMED.

Proceedings  
IREAPS Technical Symposium  
September 15-17, 1981  
Baltimore, Maryland



INSTITUTE FOR RESEARCH AND ENGINEERING FOR AUTOMATION AND PRODUCTIVITY IN SHIPBUILDING

**I R E A P S**

## SHIP STRUCTURAL COST PROGRAM

Anthony Furio  
Structural Engineer  
David Taylor Naval Shipyard  
Bethesda, Maryland

### ABSTRACT

A ship-cost computer tool has been developed to estimate U.S. Naval Surface Ship construction for both shop and field Engineered Uniform Method and Standards and current Naval shipbuilding practices.

This procedure has been incorporated into the Ship Structural Cost Program (SSCP) to provide a means of rapidly estimating structural cost for ship structures. In this form SSCP provides a three-phase cost analysis where the shop erection and field installation procedures are included in Phases 2 and 3 and the panel/grillage shop assembly procedures are included in Phase 1.

The overall aim of our cost program is to develop a cost/weight tradeoff tool that has the capability of performing weight/cost optimization tradeoff studies. This information will become useful for Navy research and design communities in assessing high cost areas in the new ship construction, identification of optimum plate-beam combinations with respect to cost and/or weight, and the identification of materials and design details which tend to reduce cost.



DAVID W. TAYLOR NAVAL SHIP  
RESEARCH AND DEVELOPMENT CENTER

Bethesda, Maryland 20884



## SHIP STRUCTURAL COST PROGRAM

AUTOMATED COST ESTIMATING TOOL

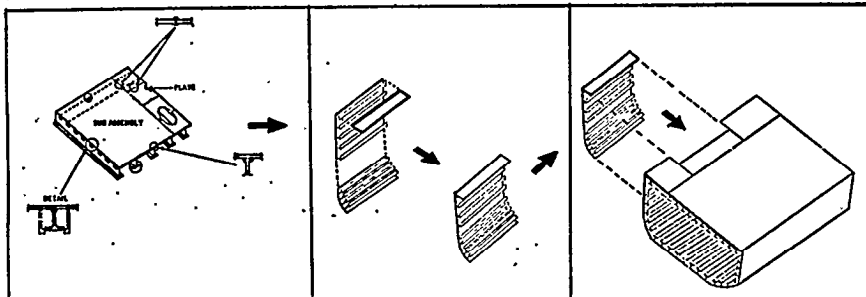
BASED ON NAVSEA

ENGINEERED UNIFORM METHODS & STANDARDS

FOR NAVAL SURFACE SHIP CONSTRUCTION

## SHIP STRUCTURAL COST PROGRAM SSCP

PHASE 1 - SUBASSEMBLY      PHASE-2 SHOP ERECTION      PHASE-3 FIELD INSTALLATION



SIGNIFICANT OPTIONS:  
GEOMETRY  
MONOHULL OR HIGH  
PERFORMANCE SHIP  
HULL AND/OR DECKHOUSE  
FLAT BAR STIFFENERS  
MATERIALS  
MS, HTS, HY80, ALUM  
DETAILS

CAPABILITIES:  
MATERIAL COST STUDIES  
CONFIGURATION STUDIES  
COST/WEIGHT OPTIMIZATION  
FUTURE IMPROVEMENTS:  
NEW DETAILS  
ALUM FIRE PROTECTION COSTS  
BALLISTIC PLATING COSTS  
WELD BONDS COSTS

# SHIP STRUCTURAL COST PROGRAM

## SSCP

---

### OBJECTIVES

LONG TERM •DEVELOP COST/WEIGHT TRADE-OFF CAPABILITY FOR EFFICIENT  
USE OF MATERIAL & STRUCTURES

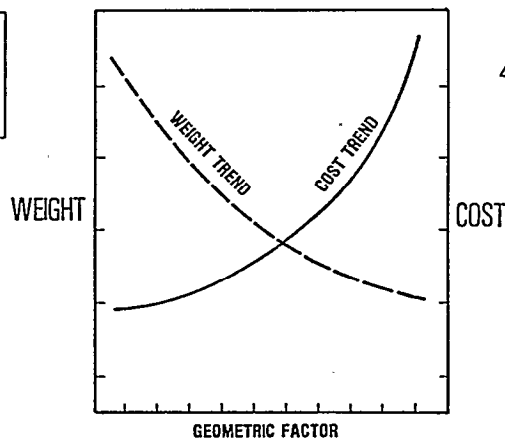
SHORT TERM •DEVELOP A COST ESTIMATION PROGRAM FOR SURFACE  
SHIP STRUCTURES

- INCORPORATE THE CAPABILITY OF NAVY DESIGN PROGRAMS  
WITH THE COST PROGRAM TO PERFORM COST/WEIGHT  
OPTIMIZATION STUDIES
- IMPROVE RELATIVE COST/WEIGHT TRADE-OFF CAPABILITY FOR  
R & D COMMUNITIES
- PROVIDE NAVAL SHIPYARDS WITH COMPUTERIZED METHOD FOR  
COST ESTIMATING REPAIR & CONVERSION
- EVALUATE HIGH COST AREAS OF SHIP CONSTRUCTION

### COST/WEIGHT TRADE-OFF

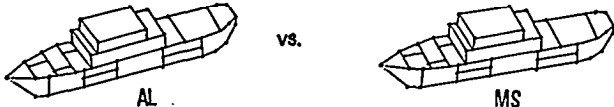
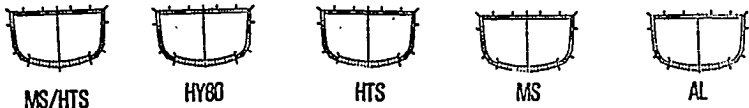
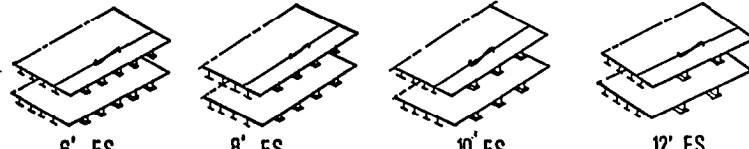
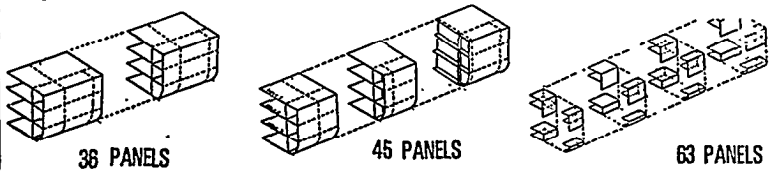
---

**COST FACTORS**  
GEOMETRY  
LOADING  
MATERIAL COST  
PRODUCTION COST

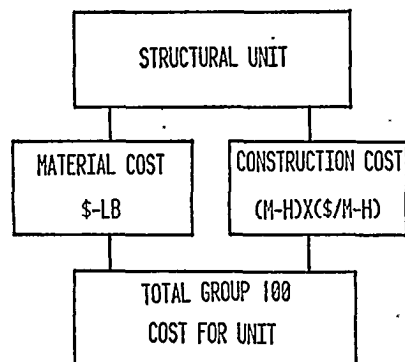


## SSCP APPLICATIONS

[RELATIVE COST COMPARISONS]

MATERIAL COST STUDY	 <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">AL</div> <div>vs.</div> <div style="text-align: center;">MS</div> </div>			
CONFIGURATION STUDY SCANTLINGS	 <div style="display: flex; justify-content: space-around; align-items: center;"> <div>MS/HTS</div> <div>HY80</div> <div>HTS</div> <div>MS</div> <div>AL</div> </div>			
COST / WEIGHT OPTIMIZATION STUDY DECK SECTIONS	 <div style="display: flex; justify-content: space-around; align-items: center;"> <div>6' F.S.</div> <div>8' F.S.</div> <div>10' F.S.</div> <div>12' F.S.</div> </div>			
CONFIGURATION STUDY MODULAR	 <div style="display: flex; justify-content: space-around; align-items: center;"> <div>36 PANELS</div> <div>45 PANELS</div> <div>63 PANELS</div> </div>			

## BASIC CONCEPT

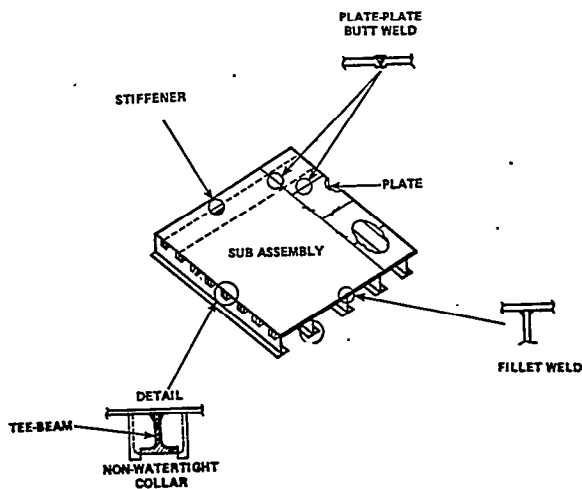




## PHASE 1-SHOP FABRICATION & WELDING

---

COST
LOFTING
LAYOUT
CUT & BURN
ROLLING
ASSEMBLY
WELDING



### ENGINEERED UNIFORM METHODS & STANDARDS TITLE I STRUCTURAL-LOFT LAYOUT & MACHINE

---

#### ◦ LOFT

DEVELOP & BUILD TEMPLATES & DRAWINGS 1/10 SCALE (PLATES & SHAPES)

#### ◦ LAYOUT

TRANSFERRING TEMPLATES & DRAWINGS (PLATES & SHAPES)

### TITLE I BURN FLAME CUT PRODUCTION

---

#### ◦ PLATES

TELEREX 90° CUT

RADIOGRAPH BEVEL CUTTING

SAW CUT ALUM

SHEARING AL & ST

#### ◦ STIFFENERS & DETAILS

MANUAL HAND GUIDED

90° CUT & BEVEL CUTTING

SHEARING ALUM

**ENGINEERED  
UNIFORM METHODS & STANDARDS  
TITLE, ROLLING OPERATIONS**

---

PLATING MAN HOURS AREA FUNCTION OF PLATE THICKNESS & WIDTH OF ROLL

STIFFENERS- MAN HOURS AREA FUNCTION OF THE TYPE OF MACHINE OPERATION

**TITLE : STRUCTURAL SHOP ASSEMBLY**

---

- o PLATE ASSEMBLY
- o STIFFENER ASSEMBLY
- o DETAIL ASSEMBLY
- o VAC-U-BLAST
- o PNEUMATIC SERVICES
- o BURNING & WELDING SERVICES
- o CRANE SERVICES

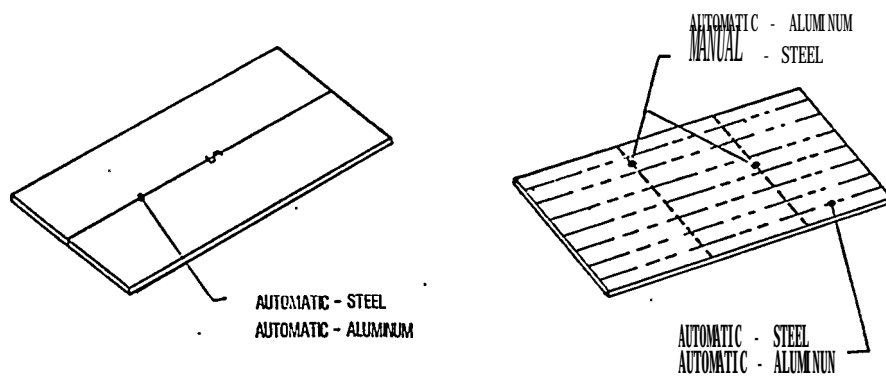
**TITLE : WELDING , STRUCTURAL PRODUCTION**

---

- o MANUAL WELDING ( MS, HTS, HY80 )  
SHIELDED METAL ARC .
- o AUTOMATIC WELDING  
SUBMERGED METAL ARC ( MS, HTS )  
GAS METAL ARC (ALUM)
- o INSPECTION
  - A- NO N.D.T
  - B- BASIC N.D.T
  - C- FULL N.D.T

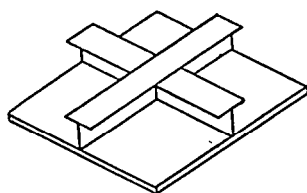
## PLATE & STIFFENER WELDING

---

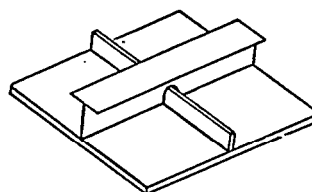


## STIFFENER INTERSECTIONS

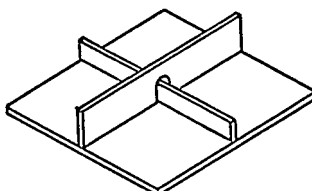
---



TEE-TEE



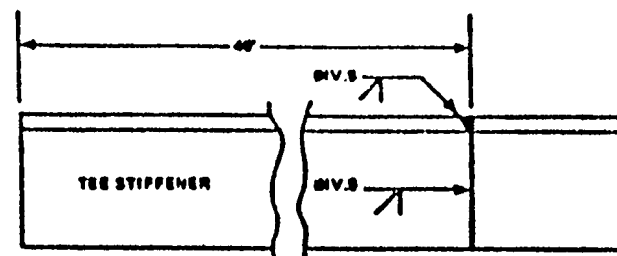
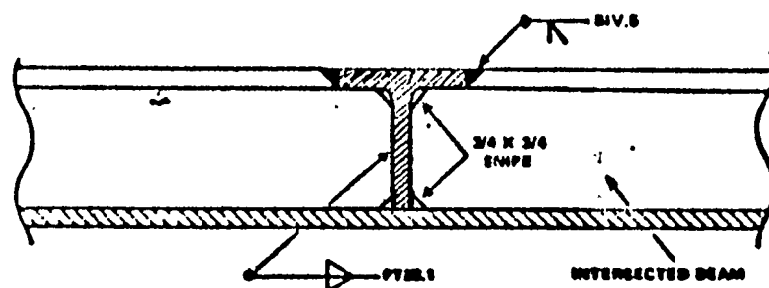
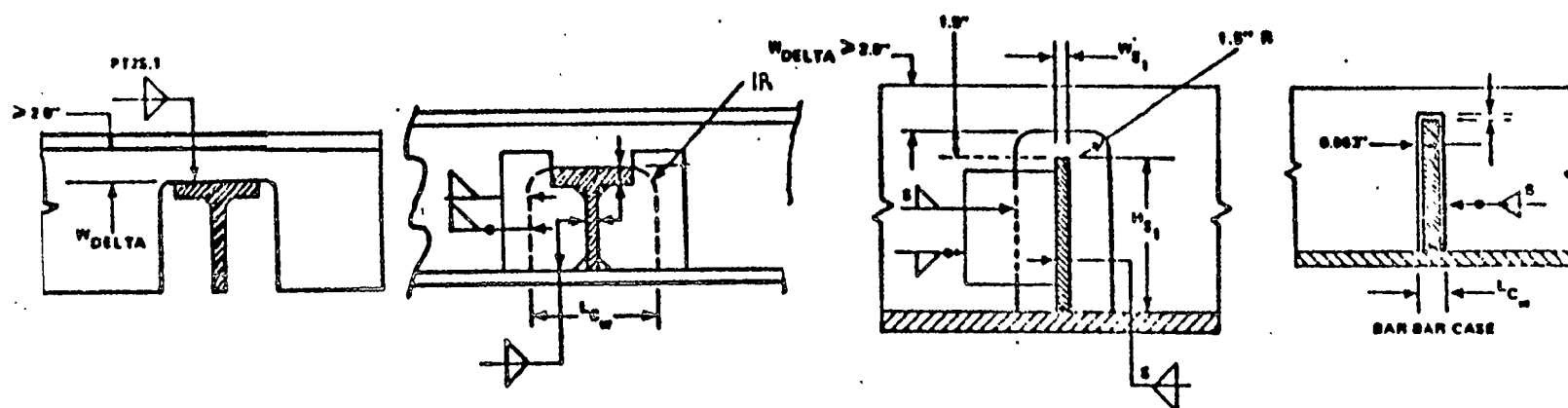
TEE-BAR



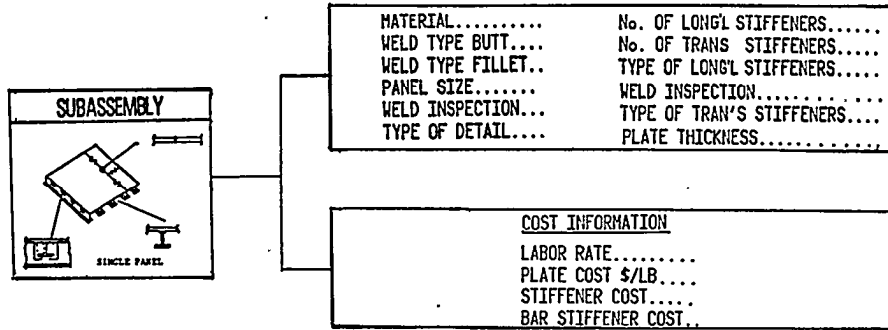
BAR-BAR

## STIFFENER INTERSECTIONS DETAILS

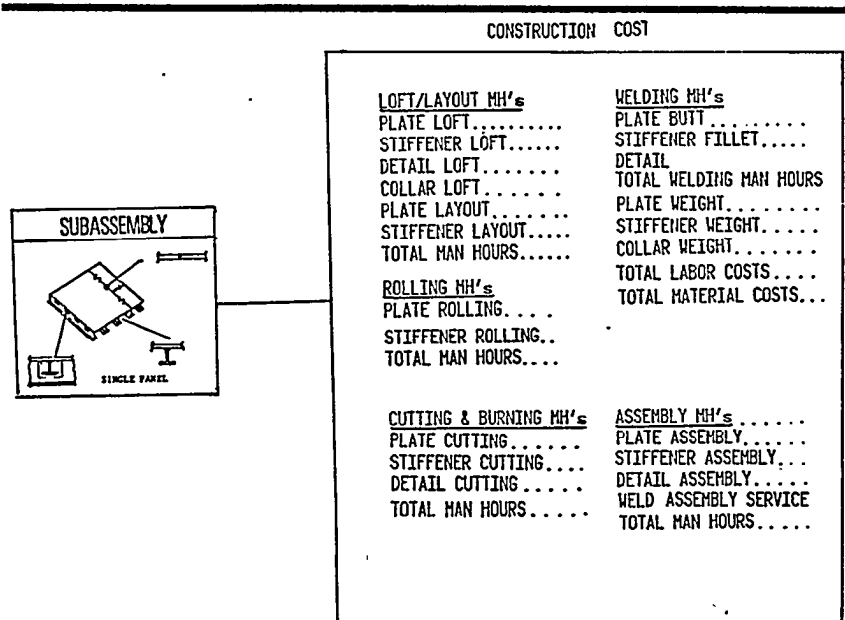
**-SAMPLE-**



## OUTPUT - PHASE 1

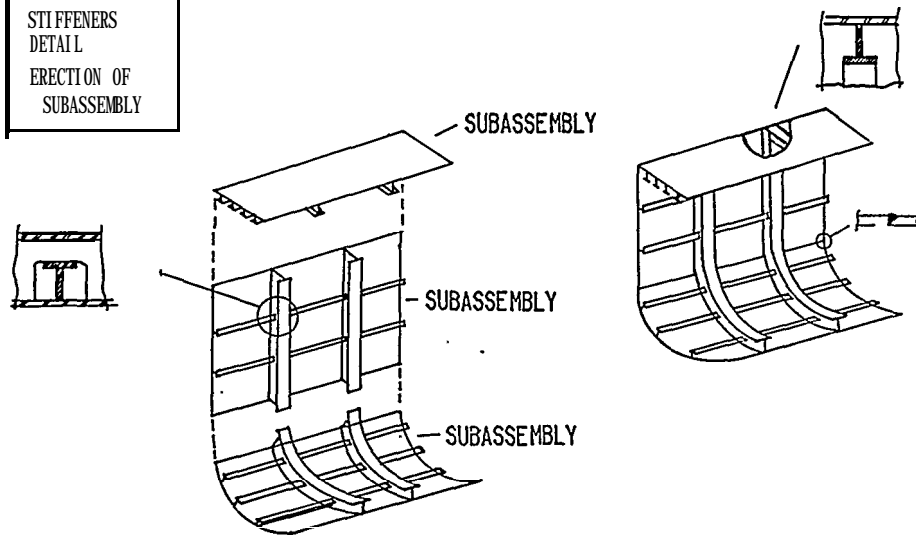


## OUTPUT - PHASE 1

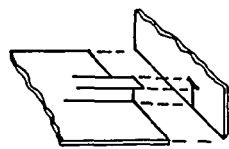


## PHASE 2 - SHOP ERECTION

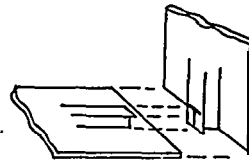
COST INFORMATION
PLATE
STIFFENERS
DETAIL
ERECTION OF
SUBASSEMBLY



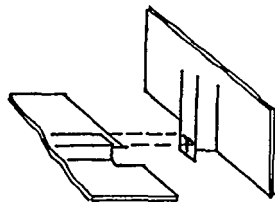
## PAN EL JOINTS



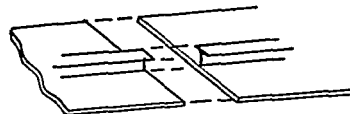
-STIFFENER BUTTED AGAINST  
PLATE



- END STIFFENER CUT  
- STIFFENER BUTTED



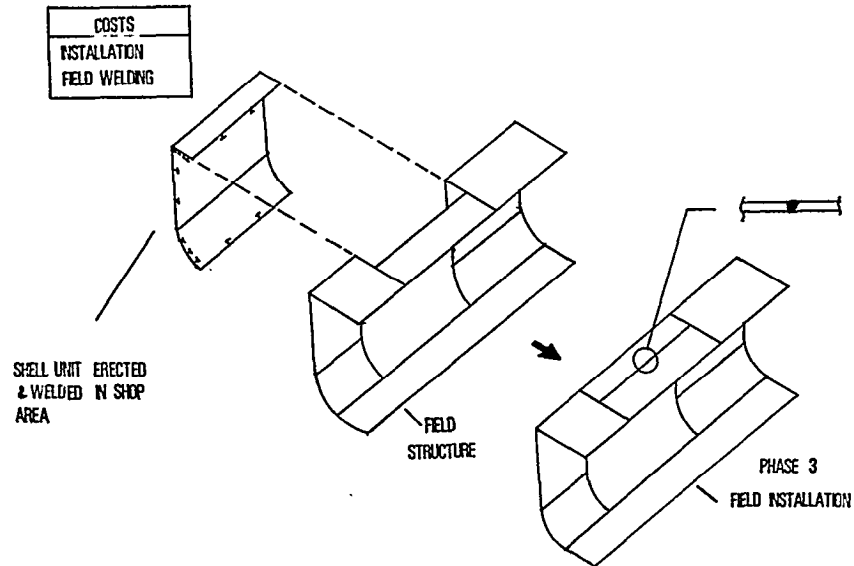
-END STIFFENER CUT  
-cutout PLATE.  
'STIFFENER BUTTED



-STIFFENER BUTTED  
-SAME SIZE

## PHASE 3 - FIELD INSTALLATION

---



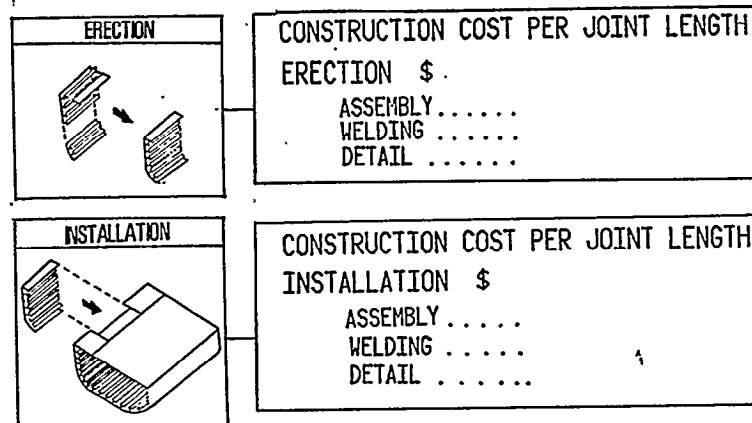
### ENGINEERED UNIFORM METHODS & STANDARDS TITLE 1 STRUCTURAL FIELD INSTALLATION

---

- 0 SHELL
- 0 DECK
- 0 BULKHEADS
- 0 STANCHIONS
- 0 SIDE & WEB FRAMES
- 0 DECKHOUSE
- 0 SHELL UNIT
- 0 BOW UNIT
- 0 STERN UNIT

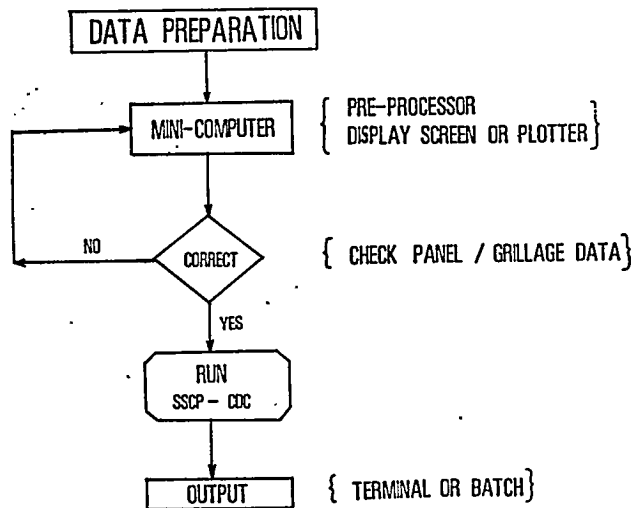
## OUTPUT - PHASE 2-3

---



## PROGRAM EXECUTION SCHEME

---

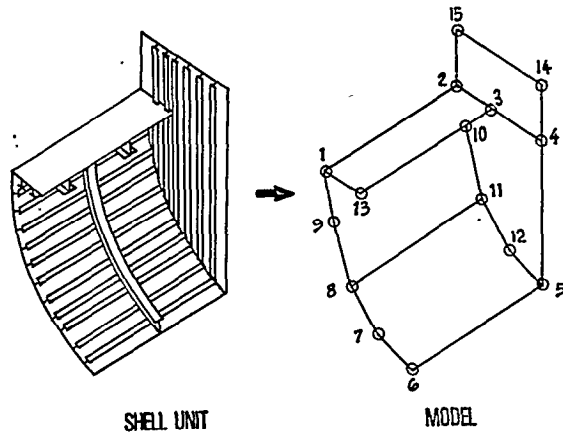




## COST MODEL INPUT DATA

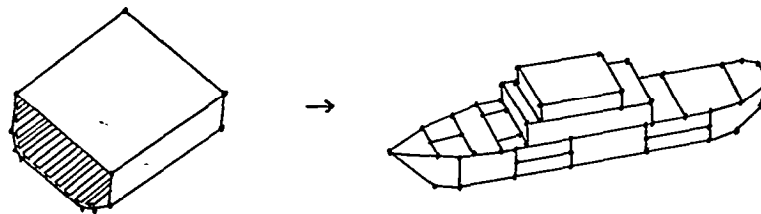
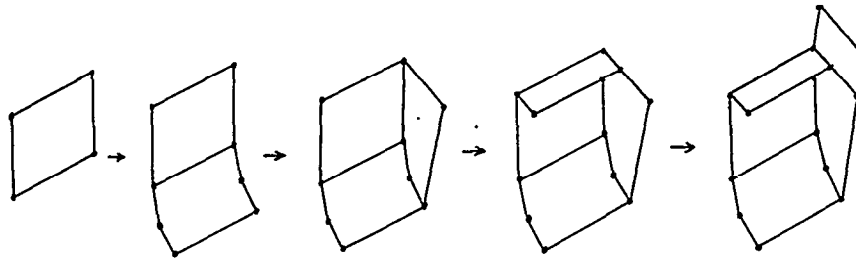
---

INITIAL DATA
MATERIAL COST
LABOR COST
PANEL DATA
NODES
GEOMETRY
SCANTLING
DETAILS
WELD INSP.
CONSTR. SEQUENCE
PLATE SIZE CATALOG



## CONSTRUCTION COST MODEL

---



## FUTURE WORK

---

- AUTOMATED COST/WEIGHT OPTIMIZATION PROGRAM
- DEVELOP COST ESTIMATING TOOL (REPAIR & CONVERSION)  
FOR NAVAL SHIPYARDS

DEVELOP COST ESTIMATING TOOL (REPAIR & MAINTENANCE)  
FOR NAVAL SHIPYARD

Additional copies of this report can be obtained from the  
National Shipbuilding Research and Documentation Center:

**<http://www.nsnet.com/docctr/>**

Documentation Center  
The University of Michigan  
Transportation Research Institute  
Marine Systems Division  
2901 Baxter Road  
Ann Arbor, MI 48109-2150

Phone: 734-763-2465  
Fax: 734-763-4862  
E-mail: [Doc.Center@umich.edu](mailto:Doc.Center@umich.edu)